

Spruce needle rust -*Chrysomyxa abietis*

Chrysomyxa abietis is an autoecious microcyclic rust, producing the telial stage on the needles of species of *Picea* (spruce). Only the current years needles of *Picea* are infected and those needles are shed early. Reported from northern Europe and Asia, the fungus is a Regulated Pest for the United States. It is absent from North America, where susceptible species are native, and Australia and New Zealand, where they are introduced. Although usually not a significant problem in its native range because conditions are not favorable for heavy infections every year (Smith et al., 1988; Hansen, 1997), this rust could be more damaging as an invasive in other temperate areas. Because small amounts of infection may be overlooked, accidental introduction could occur through importation of infected seedlings or young trees.

Chrysomyxa abietis (Wallr.) Unger

Telia hypophyllous, on yellow to orange spots or bands, elongate, erumpent, waxy, orange to orange-brown; teliospores aseptate, hyaline, oblong to ovoid-obovoid, 14-42 x 9-16 µm (mean 25 x 12 µm), wall thin, smooth, produced in easily separating chains from branched hyphae.

See Mordue and Gibson, 1978; Hiratsuka et al., 1992.

Host range: Known on many species of *Picea*.

Geographic distribution: This rust is present in northern and eastern Europe and in northern Asia (CABI, 1989). It is uncommon in the United Kingdom (Wilson and Henderson, 1966; Ellis and Ellis, 1997). It is known to occur in European Russia and the Baltic countries (Kuprevich and Tranzschel, 1957), Siberia, and the Caucasus region (Hiratsuka et al., 1992). In China, it is only reported on one species of *Picea* in one central province (Cao et al., 2000). Takahashi and Saho (1985) describe evidence of a possible different race on the northern Japanese island of Hokkaido. Although there was one known introduction to the United States in 1907 (Spaulding, 1961), this species is not currently found in North America, where susceptible spruce species are native, or Australia and New Zealand, where they have been introduced (USDA-ARS, 2009).

Similarities to other species: There are a number of species of *Chrysomyxa* and other genera of rusts on *Picea* in different areas of the Northern Hemisphere, but most either infect only the cone scales and/or produce the aecial stage, not the telial stage, on the conifer host. The aeciospores of those heteroecious rusts are yellow-orange, strongly warted, and produced in chains with alternating disjunct cells (Crane, 2001) and are thus quite different from *C. abietis*. Of the species that produce telia on needles of *Picea*, *C. weirii* Jackson in North America and Asia has narrower, hyaline, oblong to fusiform teliospores, 16-28 x 5-7 µm, in unbranched chains (Weir, 1923); in Asia, *C. Piceae* Barclay (a *Ceropsora Piceae* (Barcl.) Bakshi & Singh) has large teliospores, 98-154 x 14-24 µm, that are not in chains (Mordue and Gibson, 1978). *Melampsorella caryophyllacearum* J. Schroet causes witches broom symptoms, the proliferation of shoots, primarily on firs, but it is reported on *Picea* in the United States (Anon., 1960). Like other heteroecious rusts, this species produces aecia containing orange-yellow, warted aeciospores on infected needles (Hiratsuka et al., 1992). *Pucciniastrum areolatum* Oth. (a *Thekopsora areolata* (Fries) Magnus) produces aecia on cone scales, not needles, of *Picea* in northern Europe and northern Asia (Hiratsuka et al., 1992). According to Sinclair and Lyon (2005), yellowing and defoliation may occur to the current years needles of certain spruce species as a result of fluoride injury. Chlorosis develops from needle tips and the affected portion eventually turns red-brown. Older needles also develop symptoms but more slowly. Other sensitive species growing nearby would show injury symptoms, and a source of the air pollutant could likely be identified. See also USDA/APHIS, 2009.

Detection and inspection methods: Yellow transverse bands appear in the current years new needles. Linear orange-brown telia are produced in those bands on the undersides of the needles in late summer or autumn, and persist through the winter (Wilson and Henderson, 1966; Smith et al., 1988).

Symptoms: Infections only occur on the current years needles. Light yellow spots appear at points of infection, usually merging to form deep yellow transverse bands across the leaf. If infection is extensive, trees or entire stands may appear yellow rather than green. Most of the infected needles are dropped the following spring after telia have matured and sporulated (Murray, 1955; Wilson and Henderson, 1966; Mordue and Gibson, 1978).

Biology and Ecology: Thin-walled haploid basidiospores infect young needles in the spring; only the young needles are susceptible. Basidiospores release occurs at night during a period of weeks that roughly corresponds to the time of the new needle flush (Collins, 1976a). Infection is heaviest when the spring is cold, so that shoot growth is delayed and susceptible needles are more numerous at the time of

basidiospore dissemination (Murray, 1953). Spermatogonia, the mating structures in rusts, are not produced (Hiratsuka et al., 1992), and plasmogamy between haploid mycelium occurs within the needle (Wilson and Henderson, 1966). Since multiplication on an alternate host is not required, epidemics of this rust can develop quickly in favorable conditions (Hansen, 1997). Telia develop on the current years needles in autumn, persist over winter, and erupt through the epidermis to produce and disseminate basidiospores in the spring (Smith et al., 1988).

Associations: Telia are sometimes parasitized by the fungus *Eudarlucacaricis* (Murray, 1953), and may be fed upon by larvae of a cecidomyiid fly (Grill et al., 1983).

Natural dispersal: Sporidia (basidiospores) are distributed by wind and rain (Collins, 1976a).

Vector transmission: Unknown

Accidental introduction: This rust species was introduced once, without establishment, into the United States on nursery stock of *Picea abies* from Denmark in 1907 (Spaulding, 1961). Importation on live plant material for ornamental use, including production of Christmas trees, is still considered the likely means of accidental introduction (Schrader and Hennon, 2005; Cech, 2007).

Economic impact: Infections will reduce tree growth in severe years. Otherwise, losses are slight and transient, except when seedlings or young trees are exposed to heavy inoculum from nearby sources (Collins, 1976b; Hansen, 1997). Takahashi and Saho (1985) describe an epidemic in a plantation of *Picea engelmannii* seedlings that resulted in a 90% infection rate and the need to destroy all of the seedlings.

Prevention: Introduction on nursery stock or ornamental products should be prevented (Spaulding, 1961; Schrader and Hennon, 2005; Cech, 2007).

Cultural control: Sources of inoculum should be removed from the neighborhood of nurseries and Christmas tree plantations (Hansen, 1997; Cech, 2007). Thinning to improve air flow in young dense stands of plantations may be worthwhile (Smith et al., 1988)

Chemical control: Chemical applications could be feasible for nurseries and Christmas tree plantations, but cultural controls are preferred (Hansen, 1997).

Use of host resistance: Variation in susceptibility or severity of disease among *Picea* species has, in general, not been recorded. *Picea mariana* (Mill) Britton et al. is one of the North American species planted in Europe (Spaulding, 1956) for which there is no report of susceptibility to *C. abietis*. Takahashi and Saho (1985) report observations in Japan of rust-host interactions different from those known in Europe, suggesting the existence of a race of the fungus; selection of resistant species for cultivation in Japan is possible. Only one species of host is recorded from China (Cao et al., 2000), and the susceptibility is not known of others particular to China and central Asia, such as the Himalayan *P. smithiana* (Wall.) Boiss. (USDA-ARS, 2009).

Gaps in Knowledge/Research Needs: Variation in rust genotype and differences in susceptibility of hosts have not been examined. No DNA sequence for this species is available in the GenBank database.

References

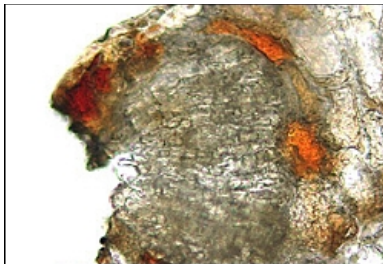
Suggested citation: Chalkley, D..Systematic Mycology and Microbiology Laboratory, ARS, USDA. . Invasive Fungi. Spruce needle rust -*Chrysomyxa abietis*. Retrieved March 25, 2016, from /sbmlweb/fungi/index.cfm .

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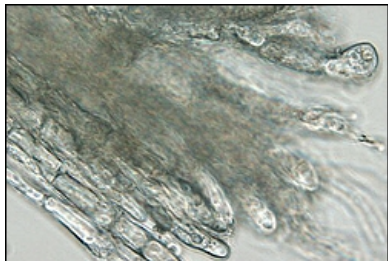
Needles showing yellowed bands, waxy immature telia and erumpent telia. 7.5 X. BPI 139663; on *Picea* sp. BPI 139663



Telium in cross-section. 200X. BPI 139663; on *Picea* sp. BPI 139663



Teliospore chains. 400X . BPI 139688; on *Picea abies*. BPI 139688



Teliospore chain. 400X. BPI 139688; on *Picea abies*. BPI 139688

